qualitative one. Fluctuating variations *may* be (and sometimes are) very considerable, while mutational changes *may* be extremely small. The difference between them may perhaps be best appreciated by saying that a fluctuating variation is the outcome of a changed environment on an otherwise unchanged mechanism, whilst a mutation is the result of a changed internal mechanism, and even with a constant environment the product will not be identical with that of the unchanged type reacting with a similar environment. It is the change of the vital machinery which *necessarily* will shift the metabolism of the organism into a new channel, and henceforth will produce a new form, stable, until once more the constitution, or chemico-mechanical framework of the race, undergoes further modification. The change itself may be small or it may be large, but it is essentially in its occurrence at all, and independently of its magnitude, that the production of a mutation depends. Furthermore, that to this *new constitution* is owing the circumstances that mutants are on such a different plane from fluctuating varieties so far as reversions are concerned. It may be argued that this smacks rather of hypothetical statement than of proved explanation of the facts, but it may be urged that fluctuating variations and mutations at any rate do express *distinct kinds* of variations, that these are not merely quantitatively different, and that it is therefore probable that they depend on the existence of different factors, in the two categories.

The second portion of the volume deals with plant physiology. It is written in the incisive style we have been accustomed to expect from the late Prof. Barnes; the arrangement of the material is good, and the mode of presentation appears to us to be very well suited to the requirements of those classes of students for whom it is designed. A cautious attitude which is much to be commended on general grounds is observed towards many "explanations" of physiological phenomena. Many interesting data not commonly met with in works of this kind are included, and render the book valuable to student and teacher alike.

It will be apparent from the foregoing that we expect the "Chicago Text-book" to take its place as a valuable addition to the class books of botany, and we hope the appearance of the concluding part may not be long delayed. J. B. F.

PRACTICAL ZOOLOGY.

Leitfaden für das zoologische Praktikum. By Prof. Willy Kükenthal. Fünfte umgearbeitete Auflage. Pp. viii+320. (Jena: Gustav Fischer, 1910.) Price 7 marks.

IT is a significant fact that no British zoologist has yet thought it worth while to write a text-book of practical zoology on the lines of Prof. Kükenthal's admirable work, which has now reached its fifth edition. The reason is perhaps to be found in the fact that zoology is so very lightly esteemed by those who have the ordering of our educational system. For this no doubt zoologists themselves are largely to blame. The specialisation of original research during the last twenty years has led to the accumulation of an enormous number of facts, which, though valuable and interesting in themselves, are from the educational point of view to a very large extent redundant.

The student is expected to familiarise himself with a vast mass of minute morphological, embryological, and systematic details, as well as with a great deal of more or less speculative matter, much of which has not yet stood the test of time. He can scarcely see the wood for the trees, and realises that the subject has become one of the most difficult, if not quite the most difficult, which he can take up for examination purposes. At the same time, the almost complete absence of zoology from our school curricula renders the subject comparatively useless from the point of view of the student who is qualifying himself as a teacher. In Germany the study of zoology appears to be much better appreciated, and this is probably largely due to the fact that teachers treat it more reasonably and do not expect their students to accomplish an impossible task.

The work before us affords an excellent survey of the animal kingdom from the laboratory point of view. It is divided into twenty "Kurse," each dealing with a special group of animals. We do not know how long each "Kursus" is supposed to occupy, but the subject-matter dealt with in each would in this country be regarded as far too much for a single practical class. Thus the frog, the pigeon, the lizard, and the rabbit are each dealt with in a single "Kursus," and so are no fewer than thirteen types of Protozoa. Each "Kursus" consists of technical instructions, a general review of the group or groups dealt with, and a special description of selected types.

The plan of the work is very well carried out, and the numerous illustrations are excellent. Students of Marshall's "Frog," or Marshall and Hurst's Zoology, would no doubt regard the treatment of types as very superficial, but it is at any rate an open question whether it is not more important to gain a really comprehensive first-hand knowledge of the animal kingdom than to attempt to deal with a very small number of types in great detail. It must be borne in mind that Prof. Kükenthal's book is apparently intended for students of "Hochschulen," who are only taking a single year's work in zoology. For those who are able to take two or three years we do not doubt that the mode of treatment adopted in the English text-books above named would be preferable for the first year, but a work such as that under review, sufficiently amplified, is badly wanted for more advanced students in this country. A. D.

IONISATION OF GASES BY COLLISION.

The Theory of Ionisation of Gases by Collision. By Prof. John S. Townsend, F.R.S. Pp. xi+88. (London: Constable and Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

IN various papers published during the last ten years Prof. Townsend has developed a theory of the ionisation of gases by collision, and has published experimental results which give it strong confirma-

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tion. In this small book he now gives a connected statement of all his work.

The phenomena attending the passage of electricity through gases are in many cases very complex, but it has certainly been evident of late years that the fog which has covered the field of exploration is beginning to lift. Here and there we are able to see clearly for a little way and to grasp the relations of various points to one another. The simple and satisfactory theory of ionisation by collision, which Prof. Townsend has worked out, is an instance of this improvement. He shows in the first chapter of his book how electrons set free by the action of ultra-violet light or other agents from one wall of an ionisation chamber grow in number as they are guided across the chamber by a sufficient electric force. Collisions with gas molecules add fresh electrons to the stream, and when the force is not too great the number which eventually reach the opposite wall is an exponential function of the width of the chamber. He bases his explanation on the assumptions that (1) an electron must acquire a certain velocity before it can ionise a gas molecule by colliding with it; (2) a successful collision adds one, and only one, electron to the stream; (3) an electron after a collision, successful or not, has lost all the energy it previously possessed, and starts its career afresh These assumptions can hardly be quite accurate, and the remarkable agreement between the calculated and the experimental results seems almost more than there is any right to expect. It is quite a satisfaction to find that the agreement does not hold in extreme cases, and that the failure is, as the author points out, in the right sense. The third assumption is certainly not always true; Prof. Townsend has himself shown, in later papers not discussed in this book, that an electron can acquire considerable energy in an electric field when moving through a very dry gas; in other words, that the electron does not then give up all its energy at each collision. Again, it is interesting to find that electrons are not to be supposed to be incorporated with the atoms with which they collide; or at least that it has been found possible to ignore such an effect. If the idea is a correct one, it seems unlikely that β-rays can ever be incorporated with atoms with which they collide. Thus the undoubted success of Prof. Townsend's theory opens up further questions of great interest.

In the second chapter it is shown that the positive ions must acquire far more energy than the negative before they can ionise. It is only when the electric force is very great that the influence of the positive ion is perceptible. When, however, the force reaches a certain value the combined action of the positives and the negatives is sufficient to multiply a small initial ionisation indefinitely, and there is a "discharge." The "sparking potential" can be calculated from the ionising coefficients of positives and negatives, as previously found by experiment, and here again there is an excellent agreement between calculation and actual test. A careful explanation is also given of the difference between the sparking potential and the potential necessary to maintain a discharge once started.

The argument of the book is generally quite clear, but there are occasional obscurities. On p. 23, for example, the statement is confused, though essentially accurate of course. "The element *dy* of these paths' is not a proper phrase.

The book is a welcome record of very useful and interesting work.

TWO PHOTOGRAPHIC ANNUALS.

(1) *Penrose's Pictorial Annual. The Process Year Book.* Edited by W. Gamble. Vol. xvi., 1910–11. Pp. x+192. (London: A. W. Penrose and Co., Ltd., n.d.) Price 5*s.* net.

(2) *The British Journal Photographic Almanac,* 1911. Jubilee issue. Edited by George E. Brown. Pp. 1348. (London: Henry Greenwood and Co., n.d.) Price 1*s.* net; cloth, 1*s.* 6*d.* net.

(1) "THE Process Year Book" has for its object the display of specimens of work done by each of the many and various processes of reproduction. Care is taken that each process is represented by a sample obtained with the maximum of efficiency of that process. The volume thus gives the reader an idea of the standard of the workmanship of to-day attained in each case, and also a comparison between the different kinds of results that can be secured.

There is no doubt that many of the processes of reproduction of to-day are really very fine, and a glance through these pages will probably make the reader think that it seems scarcely possible to produce better work. Yet those who are closely associated with the subject, and they are the people who know the true failings, take a somewhat pessimistic view. Thus the editor in last year's annual was of the opinion that the beautiful processes were on the downward grade, and in this volume he states "it cannot be said that the situation is much changed." The race for speed and large output, coupled with no time or desire to experiment, are among the reasons he gives for this halt, or rather retrograde movement.

Nevertheless the volume before us demonstrates that a very high stage of efficiency has already been reached, and it is possible that because such rapid progress in advancement as previously made is not maintained now, this pessimistic view is held.

The amount and quality of the work embodied in this volume is a credit, not only to the editor, Mr. William Gamble, but to the publishers, Messrs. Percy Lund Humphries and Co., Ltd., and the proprietors, Messrs. A. W. Penrose and Co., Ltd. A large number of brief but interesting chatty articles on various branches of the subject are interspaced among the large number of illustrations, and the variety and high standard of the latter are to be highly commended.

Every trouble has been taken to give credit to those who have contributed to the volume, and it may be said that this issue even excels the very excellent volumes which have been noticed before in these columns.

Not only will the book be of high interest to all

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